



Announces the Ph.D. Dissertation Defense of

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for the degree of Doctor of Philosophy (Ph.D.)

“Influence of Voids on Water Uptake in Polymer Panels”

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777 Glades Rd., Engineering East (EE), 405
Boca Raton, FL

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ABSTRACT OF DISSERTATION

Influence of Voids on Water Uptake in Polymer Panels

The influence of voids on the moisture uptake of epoxy has been studied. Specimens with void contents from 0 to about 50% were prepared. Void geometry and content were analyzed using microscopy and density methods. Void containing dry samples were characterized by Differential Scanning Calorimetry and Dynamic-Mechanical Analysis which verified consistency of chemistry of the epoxy network. The moisture uptake of specimens immersed in distilled water at 40 °C was monitored. The rate of absorption and saturation moisture content increased with increasing void content. The moisture uptake of void-free and void containing specimens was non-Fickian. The Langmuir model provided good fits to the experimental results for specimens with low to medium void content, although the high void content specimens showed substantial deviations from the Langmuir diffusion model. The moisture diffusivity agreed reasonably with the Maxwell inclusion model over a range of void contents from 0 to 50%.

The effect of voids on the state of water absorbed in epoxy has been examined using DSC analysis. Mass balance calculations revealed that only 6-8% of the void volume is occupied by water at saturation. Absorbed water may be classified as free and bound water. For void-free specimens, only bound water was found. Analysis of the medium and high void content specimens revealed water absorbed in three states: free water, freezable bound water, and non-freezable bound water. The DSC results show that the proportions of free water and

freezable bound water increase with increasing void content, while the content of non-freezable bound water decreased. Moisture induced swelling decreased with increasing void content. The swelling is attributed to the content of non-freezable bound water.

BIOGRAPHICAL SKETCH

Born in Egypt
B.S., Aswan University, Aswan, Egypt, 1998
M.S., Aswan University, Aswan, Egypt, 2005
Ph.D., Florida Atlantic University, Boca Raton, Florida, 2018

CONCERNING PERIOD OF PREPARATION
& QUALIFYING EXAMINATION

Time in Preparation: 2015 – 2018

Qualifying Examination Passed: Fall 2015

Published Papers:

Abdelmola, F. and Carlsson, L. A., 2018. Water uptake in epoxy matrix with voids: experiments and modeling. *Journal of Composite Materials*, (In press).

Fatamaelzahraa Abdelmola and Leif A. Carlsson, 2018, State of Water in Void-free and Void Containing Epoxy Specimens (Submitted, *J. Reinf. Plastics and Composites*).

Fatamaelzahraa Abdelmola and Leif A. Carlsson, State of Water Absorbed in Epoxy with Voids, (Accepted, 2018 MRS Fall meeting in Boston: Abstract).